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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :
G08B 5/22, H04B 1/16, H04Q 1/56, 9/14 | A1

(11) International Publication Number: WO 94/17502

(43) International Publication Date: 4 August 1994 (04.08.94)

(21) International Application Number: PCT/US94/00775

(22) International Filing Date: 18 January 1994 (18.01.94)

(30) Priority Data:
08/007,226 22 January 1993 (22.01.93) US

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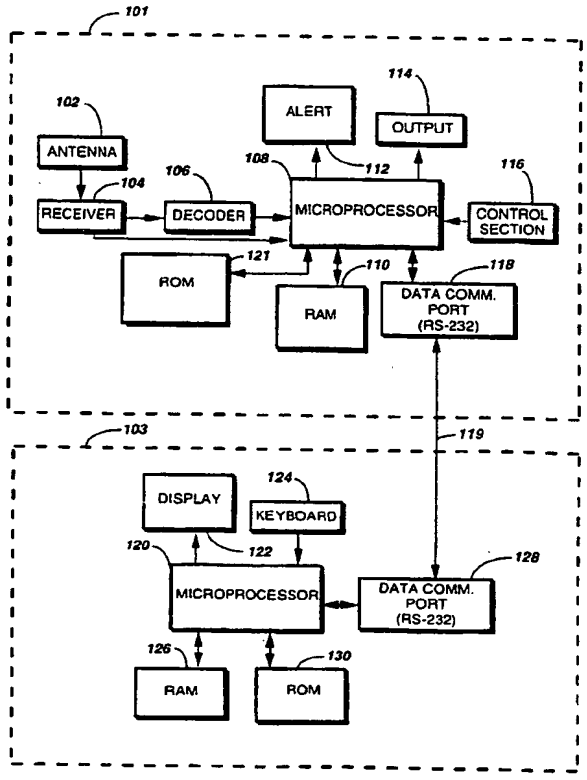
(81) Designated States: AT, AU, BB, BG, BR, BY, CA, CH, CZ, DE, DK, ES, FI, GB, HU, JP, KR, KZ, LK, LU, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK, UA, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

**Published**
*With international search report.*
*Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.*

(54) Title: METHOD AND APPARATUS FOR ESTABLISHING DATA COMMUNICATIONS BETWEEN POWER-CONSERVING DEVICES

(57) Abstract

A method and apparatus for initiating data communications from a radio communication device (101) to a computing device (103), the radio communication device (101) capable of operating in both a power-conserving, limited-function mode and a full-function mode. The radio communication device (101) elevates operation to the full-function mode in response to a need to communicate with the computing device (103), then transmits to the computing device (103) an attempt to communicate. The radio communication device (101) continues operation in the full-function mode for a predetermined response time period after completing the attempt to communicate, and retransmits the attempt to communicate in response to receiving a retry request from the computing device (103) before expiration of the predetermined response time period.



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# METHOD AND APPARATUS FOR ESTABLISHING DATA COMMUNICATIONS BETWEEN POWER-CONSERVING DEVICES

## Field of the Invention

This invention relates in general to data communications devices, and more specifically to a method and apparatus for establishing data communications between power-conserving devices.

## Background of the Invention

Portable, battery powered radio communication devices and portable, battery powered computing devices are well known. Such devices typically operate in a full-function mode while receiving, transmitting, and actively processing information, and then revert automatically to a power-conserving, limited-function mode after a period of inactivity to minimize use of battery power.

When such a portable radio communication device and such a portable computing device must communicate occasionally with each other, a communication attempt can fail because the intended recipient of the communication is in the power-conserving, limited-function mode when the communication attempt occurs.

Thus, what is needed is a method and apparatus for preventing the failure of a communication between a portable radio communication device and a portable computing device due to the intended communication recipient being in the power-conserving, limited-function mode, while allowing the continued use of the power-conserving, limited-function mode to extend battery life.

## Summary of the Invention

One aspect of the present invention is a method of initiating data communications from a radio frequency (RF) communication device to a computing device, each device having a data communication port, the RF communication device capable of operating in both a power-conserving, limited-function mode and a full-function mode. The method comprises in the RF communication device the steps of elevating operation to the full-function mode in response to a need to communicate with the computing device, and transmitting to the computing device an attempt to communicate following the elevating step. The method further comprises the steps of continuing operation in the full-function mode for a first predetermined response time period after completing the transmitting step, and retransmitting the attempt to communicate in response to receiving a retry request from the computing device before expiration of the first predetermined response time period.

Another aspect of the present invention is a method of initiating data communications from a computing device to an RF communication device, each device having a data communication port, the RF communication device capable of operating in both a power-conserving, limited-function mode and a full-function mode. The method comprises in the RF communication device the step of detecting, in response to an attempt to communicate from the computing device while the RF communication device is in the power-conserving, limited-function mode, that activity has occurred on the data communication port of the RF communication device. The method further comprises advancing operation to the full-function mode in response to detecting the activity, and sending to the computing device a retry request after the advancing step. The method further comprises remaining in the full-function mode for a first predetermined response time period after completing the sending step, and establishing communications with the computing device in

response to receiving a retransmitted attempt to communicate from the computing device before expiration of the first predetermined response time period.

Another aspect of the present invention is an RF communication device capable of operating in both a power-conserving, limited-function mode and a full-function mode, the RF communication device comprising an RF receiver for receiving radio signals comprising information. The RF communication device further comprises a processor coupled to the RF receiver for processing the received information, and a data communication port coupled to the processor for communicating with a computing device. The RF communication device further comprises a first processing element for elevating operation to the full-function mode in response to a need to communicate with the computing device, and a second processing element coupled to the first processing element for transmitting to the computing device an attempt to communicate following elevation to the full-function mode. The RF communication device further comprises a third processing element coupled to the second processing element for continuing operation in the full-function mode for a predetermined response time period after transmitting the attempt to communicate, and a fourth processing element coupled to the third processing element for retransmitting the attempt to communicate in response to receiving a retry request from the computing device before expiration of the predetermined response time period.

Another aspect of the present invention is an RF communication device capable of operating in both a power-conserving, limited-function mode and a full-function mode, the RF communication device comprising an RF receiver for receiving radio signals comprising information, and a processor coupled to the RF receiver for processing the received information. The RF communication device further comprises a data communication port coupled to the processor for communicating with a computing device, and a first

processing element for detecting, in response to an attempt to communicate from the computing device while the RF communication device is in the power-conserving, limited-function mode, that activity has occurred on the data communication port of the RF communication device. The RF communication device further comprises a second processing element coupled to the first processing element for advancing operation to the full-function mode in response to detecting the activity, and a third processing element coupled to the second processing element for sending to the computing device a retry request after advancing operation to the full-function mode. The RF communication device further comprises a fourth processing element coupled to the third processing element for maintaining the full-function mode for a predetermined response time period after sending the retry request, and a fifth processing element for establishing communications with the computing device in response to receiving a retransmitted attempt to communicate from the computing device before expiration of the predetermined response time period.

## Brief Description of the Drawings

FIG. 1 is an electrical block diagram of an RF communication device coupled to a computing device in accordance with the preferred embodiment of the present invention.

FIG. 2 is a block diagram depicting firmware elements in the RF communication device in accordance with the preferred embodiment of the present invention.

FIG. 3 is an isometric view of the RF communication device in accordance with the preferred embodiment of the present invention.

FIG. 4 is an orthographic view of the RF communication device coupled to the computing device in accordance with the preferred embodiment of the present invention.

FIG. 5 is a flow chart of operation of the RF communication device while initiating communications with the computing device in accordance with the preferred embodiment of the present invention.

FIG. 6 is a flow chart of operation of the computing device in response to communications initiated by the RF communication device in accordance with the preferred embodiment of the present invention.

FIG. 7 is a flow chart of operation of the computing device while initiating communications with the RF communication device in accordance with the preferred embodiment of the present invention.

FIG. 8 is a flow chart of operation of the RF communication device in response to communications initiated by the computing device in accordance with the preferred embodiment of the present invention.

## Description of the Preferred Embodiment

With reference to FIG. 1, an electrical block diagram of an RF communication device 101 coupled to a computing device 103, such as a laptop computer, portable computer, personal computer, electronic organizer, calculator, etc., in accordance with the preferred embodiment of the present invention comprises an antenna 102 for intercepting RF signals. The antenna 102 is coupled to a receiver 104 for receiving and demodulating the RF signals intercepted. A decoder 106 is coupled to the receiver 104 for decoding demodulated address information transmitted in any of a number of well-known signaling protocols, such as POCSAG or GSC selective call signaling. A microprocessor 108, e.g., the 68HC05C8 or C11 manufactured by Motorola, Inc. of Schaumburg, IL, is also coupled to the receiver 104 for processing the demodulated information to recover messages. The microprocessor 108 is coupled to a random access memory (RAM) 110 for storing the messages recovered, and the

microprocessor 108 controls the storing and recalling of the messages. An alert generator 112 is coupled to the microprocessor 108 for providing an audible or tactile alert to a user when the microprocessor 108 has a message ready for presentation.

An output device 114 comprises a visual display or a speaker or both, the output device 114 also being controlled by the microprocessor 108. The control section 116 comprises user accessible controls for allowing the user to command the microprocessor 108 to perform the selective call receiver operations well known to one of ordinary skill in the art and typically includes control switches such as an on/off control button, a function control, etc.

The microprocessor 108 is coupled to a read-only memory (ROM) 121 and a data communication port 118 for controlling and communicating with the ROM 121 and the data communication port 118, in accordance with the present invention. The ROM 121 comprises special processor elements, i.e., firmware elements, in accordance with the present invention. These firmware elements are described herein below in the discussion of FIG. 2.

In the preferred embodiment of the present invention the data communication port 118 is constructed and controlled in a manner that meets the well-known RS-232 serial interface standard. The data communication port 118 couples with the computing device 103 by a serial bus 119. One of ordinary skill in the art will recognize that other types of serial and parallel interfaces could be used as well.

The computing device 103, e.g., an HP95LX palmtop computer manufactured by Hewlett Packard, Inc. of Palo Alto, CA, comprises a data communication port 128 also of the RS-232 type coupled to a microprocessor 120 for communicating with the serial bus 119. The microprocessor 120 is coupled to a display 122, typically a liquid crystal

display, and a keyboard 124 for interfacing with a user. A read-only memory (ROM) 130 is coupled to and controlled by the microprocessor 120 for storing software instructions and other pre-programmed information used by the computing device 103. A random access memory (RAM) 126 is also coupled to the microprocessor 120 for storing software programs and other values received from the microprocessor 120.

Both the RF communication device 101 and the computing device 103 are capable of independently operating in a power-conserving, limited-function mode and in a full-function mode. Both devices are programmed to initiate communications with one another in accordance with the preferred embodiment of the present invention, as described below.

With reference to FIG. 2, a block diagram depicting firmware elements in the ROM 121 of the RF communication device 101 in accordance with the preferred embodiment of the present invention comprises an RF-device-initiated-communication firmware block 220 and a computing-device-initiated-communication firmware block 221. The firmware elements depicted in FIG. 2 control the operation of the RF communication device 101 in accordance with the preferred embodiment of the present invention. Similar firmware corresponding to the firmware elements of the blocks 220 and 221 also exists in the ROM 130 of the computing device 103 for controlling the operation of the computing device 103.

The RF-device-initiated-communication firmware block 220 includes a Mode Elevator 201 for elevating operation of the RF communication device 101 to the full-function mode in response to a need to communicate with the computing device 103. An Attempt Transmitter 202 is for controlling the transmission of an attempt to communicate with the computing device 103 following elevation to the full-function mode. A Full-Function Mode Continuing Element 203 is for continuing

operation in the full-function mode for a predetermined response time period after the transmission of the attempt to communicate. An Attempt Retransmitter 204 is for retransmitting the attempt to communicate in response to receiving a retry request from the computing device 103 before expiration of the predetermined response time period. A Limited-Function Mode Returner 205 is for returning operation of the RF communication device 101 to the power-conserving, limited-function mode in response to receiving no retry request before expiration of the response time period. A Data Communication Port Initializer 206 is for initializing the data communication port 118 prior to transmission of the attempt to communicate.

The computing-device-initiated-communication firmware block 221 includes a Data Communication Port Activity Detector 211 for detecting, in response to an attempt to communicate from the computing device 103 while the RF communication device 101 is in the power-conserving, limited-function mode, that activity has occurred on the data communication port 118. A Mode Advancer 212 is for advancing operation of the RF communication device 101 to the full-function mode in response to detecting the activity on the data communication port 118. A Retry Request Sender 213 is for sending to the computing device 103 a retry request after operation has advanced to the full-function mode. A Full-Function Mode Maintainer 214 is for maintaining the full-function mode for a predetermined response time period after sending the retry request. A Communications Establishment Element 215 is for establishing communications with the computing device 103 in response to receiving a retransmitted attempt to communicate before expiration of the predetermined response time period. A Limited-Function Mode Restorer 216 is for returning operation to the power-conserving, limited function mode in response to receiving no retransmitted attempt to communicate before expiration of the

predetermined response time period. A Data Port Initializer 217 is for initializing the data communication port 118 before sending the retry request.

With reference to FIG. 3, an isometric view of the RF communication device 101 in accordance with the preferred embodiment of the present invention depicts a connector comprising the serial bus 119 for interconnecting with the computing device 103.

With reference to FIG. 4, an orthographic view of the RF communication device 101 coupled to the computing device 103 in accordance with the preferred embodiment of the present invention depicts the RF communication device 101 fully inserted into an RS-232 receptacle 404 of the computing device 103. In this position, the electrical coupling provided by the serial bus 119 allows RF communication device 101 and the computing device 103 to initiate communications in accordance with the present invention.

With reference to FIG. 5, a flow chart of operation of the RF communication device 101 while initiating communications with the computing device 103 in accordance with the preferred embodiment of the present invention begins at step 502 with the RF communication device 101 in the power-conserving, limited-function mode. Next, the microprocessor 108 of the RF communication device 101 has 504 a need to communicate with the computing device 103. This need may result from, for example, the receipt of a radio message sent to the RF communication device 101. In response, the microprocessor 108, under control of the RF-device-initiated-communication firmware block 220, elevates 506 the operation of the RF communication device 101 to the full-function mode in a manner well known to one of ordinary skill in the art of battery saving techniques. Then the microprocessor 108 initializes 508 the data communication port 118 to ready it for communications.

Next, the microprocessor 108 controls 510 the data communication port 118 to transmit an attempt to

communicate with the computing device 103. The microprocessor 108 waits for a response at step 512 while checking for expiration of a predetermined response time period at step 514. If at step 514 the response time expires before getting a response, the microprocessor 108 returns 518 operation of the RF communication device 101 to the power-conserving mode.

If, on the other hand, a response occurs at step 512 before the response time has expired, then at step 516 the microprocessor 108 checks whether the response is a retry request. If not, communications have been established 520 and may be continued to completion. If, on the other hand, the response is a retry request, the microprocessor 108 controls 522 the data communication port 118 to retransmit the attempt to communicate with the computing device 103. As will become clear in the description of FIG. 6 below, operation as described herein above advantageously allows the RF communication device 101 to initiate communications with the computing device 103 even though the computing device 103 is also in the power-consuming, low-function mode at the start of the attempt to communicate.

With reference to FIG. 6, a flow chart of operation of the computing device 103 in response to communications initiated by the RF communication device 101 in accordance with the preferred embodiment of the present invention begins at step 602 with the computing device 103 in the power-conserving, limited-function mode. Next, at step 604 the computing device 103 detects 604 activity on the data communication port 128 resulting from an attempt to communicate by the RF communication device 101. The computing device 103 cannot synchronize immediately with the communication attempt, because the computing device 103 is in the power-conserving, low-function mode. In this mode, however, the computing device 103 detects activity on the data communication port 128 by means of a low level power-conserving monitor routine. In response to the

detected port activity, the computing device 103 advances 606 operation to the full-function mode. In addition, the computing device 103 initializes 608 the data communication port 128 to ready it for communications.

Next, the computing device 103 sends 610 a retry request to the RF communication device 101. The computing device 103 waits for a retransmitted communication attempt at step 612 while checking for expiration of a predetermined response time period at step 614. If at step 614 the response time expires before getting the retransmitted communication attempt, the computing device 103 returns 618 operation to the power-conserving mode. If, on the other hand, the retransmitted communication attempt occurs at step 612 before the response time has expired, then at step 616 communications have been established and can continue to completion.

Thus, in one aspect of the present invention there is advantageously provided a method and apparatus for initiating communications from an RF communication device to a computing device even though one or both devices are operating in a power-conserving, low-function mode at the time a need to communicate arises.

With reference to FIG. 7, a flow chart of operation of the computing device 103 while initiating communications with the RF communication device 101 in accordance with the preferred embodiment of the present invention begins at step 702 with the computing device 103 in the power-conserving, limited-function mode. Next, the computing device 103 has 704 a need to communicate with the RF communication device 101. This need may result from, for example, user input to the keyboard 124. In response, the computing device 103 elevates 706 its operation to the full-function mode in a manner well known to one of ordinary skill in the art of battery saving techniques. Then the computing device 103 initializes 708 the data communication port 128 to ready it for communications.

Next, the computing device 103 directs 710 the data communication port 128 to transmit an attempt to communicate with the RF communication device 101. The computing device 103 waits for a response at step 712 while checking for expiration of a predetermined response time period at step 714. If at step 714 the response time expires before getting a response, the computing device 103 returns 718 operation to the power-conserving mode.

If, on the other hand, a response occurs at step 712 before the response time has expired, then at step 716 the computing device 103 checks whether the response is a retry request. If not, communications have been established 720 and may be continued to completion. If, on the other hand, the response is a retry request, the computing device 103 directs 722 the data communication port 128 to retransmit the attempt to communicate with the RF communication device 101.

With reference to FIG. 8, a flow chart of operation of the RF communication device 101 in response to communications initiated by the computing device 103 in accordance with the preferred embodiment of the present invention begins at step 802 with the RF communication device 101 in the power-conserving, limited-function mode. Next, at step 804 the microprocessor 108 of the RF communication device 101, under control of the computing-device-initiated-communication firmware block 221, detects 804 activity on the data communication port 118 resulting from an attempt to communicate by the computing device 103. The RF communication device 101 cannot synchronize immediately with the communication attempt, because the RF communication device 101 is in the power-conserving, low-function mode. In this mode, however, the microprocessor 108 of the RF communication device 101 can detect activity on the data communication port 118 by means of the Data Communication Port Activity Detector 211, a low level power-conserving monitor routine. In response to the

detected port activity, the microprocessor 108 of the RF communication device 101 advances 806 operation to the full-function mode. In addition, the microprocessor 108 of the RF communication device 101 initializes 808 the data communication port 118 to ready it for communications.

Next, the microprocessor 108 of the RF communication device 101 sends 810 a retry request to the computing device 103. The microprocessor 108 of the RF communication device 101 waits for a retransmitted communication attempt at step 812 while checking for expiration of a predetermined response time period at step 814. If at step 814 the response time expires before getting the retransmitted communication attempt, the microprocessor 108 of the RF communication device 101 returns 818 operation to the power-conserving mode. If, on the other hand, the retransmitted communication attempt occurs at step 812 before the response time has expired, then at step 816 communications have been established and can continue to completion.

Thus, in another aspect of the present invention there is advantageously provided a method and apparatus for initiating communications from a computing device to an RF communication device even though one or both devices are operating in a power-conserving, low-function mode at the time a need to communicate arises.

The present invention advantageously provides a method and apparatus for preventing the failure of a communication between a radio communication device and a computing device due to the intended communication recipient being in a power-conserving, limited-function mode. The present invention is particularly advantageous for portable, battery powered devices, for which low power consumption is a primary requirement for extended battery life.

What is claimed is:

CLAIMS

1. A method of initiating data communications from a radio frequency (RF) communication device to a computing device, each device having a data communication port, the RF communication device capable of operating in both a power-conserving, limited-function mode and a full-function mode, the method comprising in the RF communication device the steps of:

elevating operation to the full-function mode in response to a need to communicate with the computing device;

transmitting to the computing device an attempt to communicate following said step of elevating;

continuing operation in the full-function mode for a first predetermined response time period after completing said step of transmitting; and

retransmitting the attempt to communicate in response to receiving a retry request from the computing device before expiration of the first predetermined response time period.

2. The method in accordance with claim 1, further comprising in the RF communication device the step of returning operation to the power-conserving, limited-function mode in response to receiving no retry request before expiration of the first predetermined response time period.

3. The method in accordance with claim 1, further comprising in the RF communication device the step of initializing the data communication port of the RF communication device before said step of transmitting.

4. The method in accordance with claim 1,

wherein the computing device is capable of operating in both a power-conserving, limited-function mode and a full-function mode, and

wherein the method further comprises in the computing device the steps of:

detecting, in response to the attempt to communicate from the RF communication device while the computing device is in the power-conserving, limited-function mode, that activity has occurred on the data communication port of the computing device;

advancing operation to the full-function mode in response to detecting the activity;

sending to the RF communication device a retry request after said step of advancing;

remaining in the full-function mode for a second predetermined response time period after completing said step of sending; and

establishing communications with the RF communication device in response to receiving a retransmitted attempt to communicate from the RF communication device before expiration of the second predetermined response time period.

5. The method in accordance with claim 4, further comprising in the computing device the step of returning operation to the power-conserving, limited-function mode in response to receiving no retransmitted attempt to communicate before expiration of the second predetermined response time period.

6. The method in accordance with claim 4, further comprising in the computing device the step of initializing the data communication port of the computing device before said step of sending.

7. A method of initiating data communications from a computing device to a radio frequency (RF) communication device, each device having a data communication port, the RF communication device capable of operating in both a power-conserving, limited-function mode and a full-function mode, the method comprising in the RF communication device the steps of:

detecting, in response to an attempt to communicate from the computing device while the RF communication device is in the power-conserving, limited-function mode, that activity has occurred on the data communication port of the RF communication device;

advancing operation to the full-function mode in response to detecting the activity;

sending to the computing device a retry request after said step of advancing;

remaining in the full-function mode for a first predetermined response time period after completing said step of sending; and

establishing communications with the computing device in response to receiving a retransmitted attempt to communicate from the computing device before expiration of the first predetermined response time period.

8. The method in accordance with claim 7, further comprising in the RF communication device the step of returning operation to the power-conserving, limited-function mode in response to receiving no retransmitted attempt to communicate before expiration of the first predetermined response time period.

9. The method in accordance with claim 7, further comprising in the RF communication device the step of initializing the data communication port of the RF communication device before said step of sending.

10. The method in accordance with claim 7,

wherein the computing device is capable of operating in both a power-conserving, limited-function mode and a full-function mode, and

wherein the method further comprises in the computing device the steps of:

elevating operation to the full-function mode in response to a need to communicate with the RF communication device;

transmitting to the RF communication device an attempt to communicate following said step of elevating;

continuing operation in the full-function mode for a second predetermined response time period after completing said step of transmitting; and

retransmitting the attempt to communicate in response to receiving the retry request from the RF communication device before expiration of the second predetermined response time period.

11. The method in accordance with claim 10, further comprising in the computing device the step of returning operation to the power-conserving, limited-function mode in response to receiving no retry request before expiration of the second predetermined response time period.

12. The method in accordance with claim 10, further comprising in the computing device the step of initializing the data communication port of the computing device before said step of transmitting.

13. A radio frequency (RF) communication device capable of operating in both a power-conserving, limited-function mode and a full-function mode, the RF communication device comprising:

an RF receiver for receiving radio signals comprising information;

a processor coupled to the RF receiver for processing the received information;

a data communication port coupled to the processor for communicating with a computing device;

a first processing element for elevating operation to the full-function mode in response to a need to communicate with the computing device;

a second processing element coupled to the first processing element for transmitting to the computing device an attempt to communicate following elevation to the full-function mode;

a third processing element coupled to the second processing element for continuing operation in the full-function mode for a predetermined response time period after transmitting the attempt to communicate; and

a fourth processing element coupled to the third processing element for retransmitting the attempt to communicate in response to receiving a retry request from the computing device before expiration of the predetermined response time period.

14. The RF communication device in accordance with claim 13, further comprising a fifth processing element coupled to the third processing element for returning operation to the power-conserving, limited-function mode in response to receiving no retry request before expiration of the predetermined response time period.

15. The RF communication device in accordance with claim 13, further comprising a sixth processing element coupled to the second processing element for initializing the data communication port before transmitting the attempt to communicate.

16. A radio frequency (RF) communication device capable of operating in both a power-conserving, limited-function mode and a full-function mode, the RF communication device comprising:

an RF receiver for receiving radio signals comprising information;

a processor coupled to the RF receiver for processing the received information;

a data communication port coupled to the processor for communicating with a computing device;

a first processing element for detecting, in response to an attempt to communicate from the computing device while the RF communication device is in the power-conserving, limited-function mode, that activity has occurred on the data communication port of the RF communication device;

a second processing element coupled to the first processing element for advancing operation to the full-function mode in response to detecting the activity;

a third processing element coupled to the second processing element for sending to the computing device a retry request after advancing operation to the full-function mode;

a fourth processing element coupled to the third processing element for maintaining the full-function mode for a predetermined response time period after sending the retry request; and

a fifth processing element for establishing communications with the computing device in response to receiving a retransmitted attempt to communicate from the computing device before expiration of the predetermined response time period.

17. The RF communication device in accordance with claim 16, further comprising a sixth processing element coupled to the third processing element for returning operation to the power-conserving, limited-function mode in response to receiving no retransmitted attempt to communicate before expiration of the predetermined response time period.

18. The RF communication device in accordance with claim 16, further comprising a seventh processing element coupled to the third processing element for initializing the data communication port before sending the retry request.

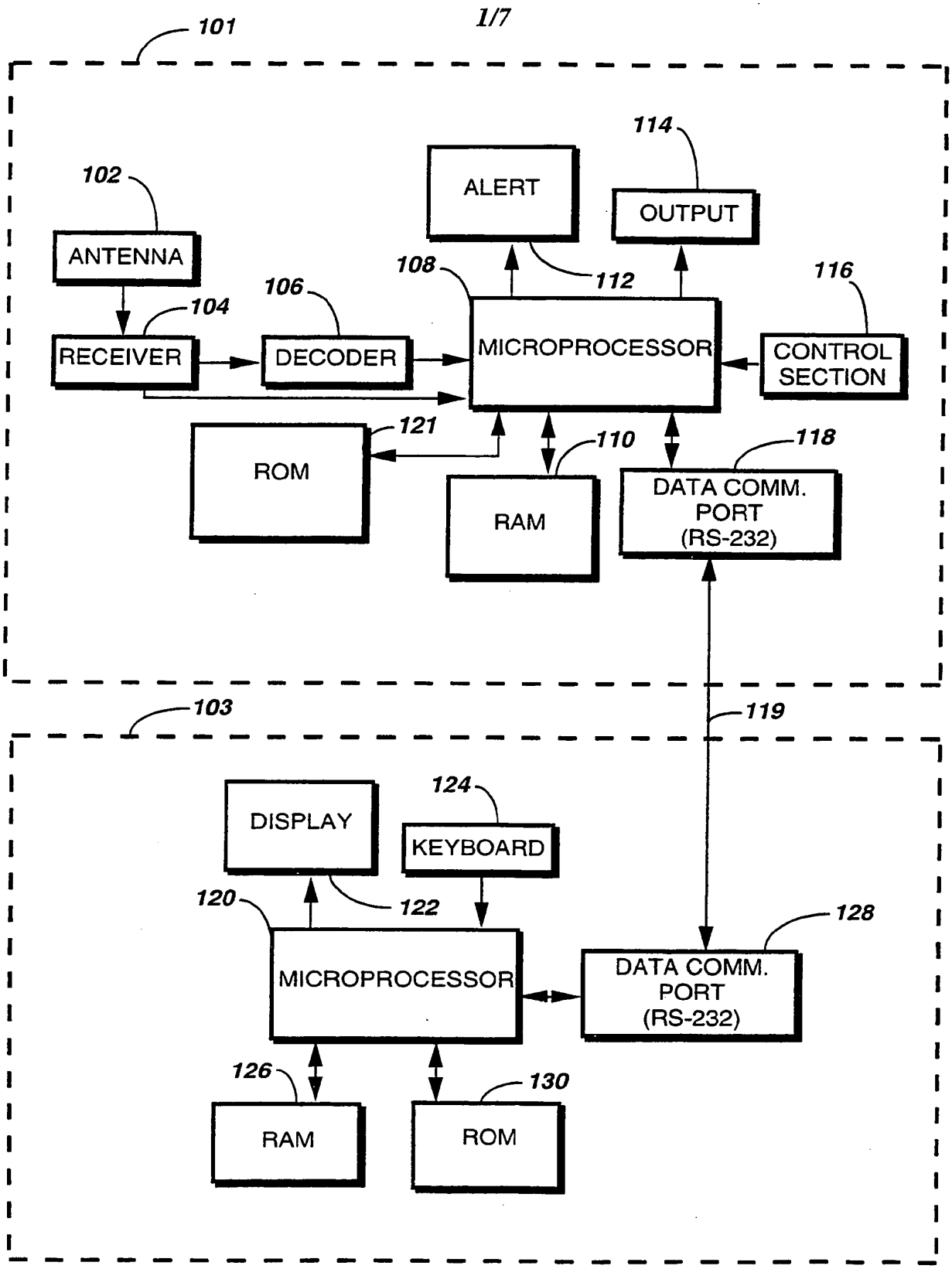


FIG. 1

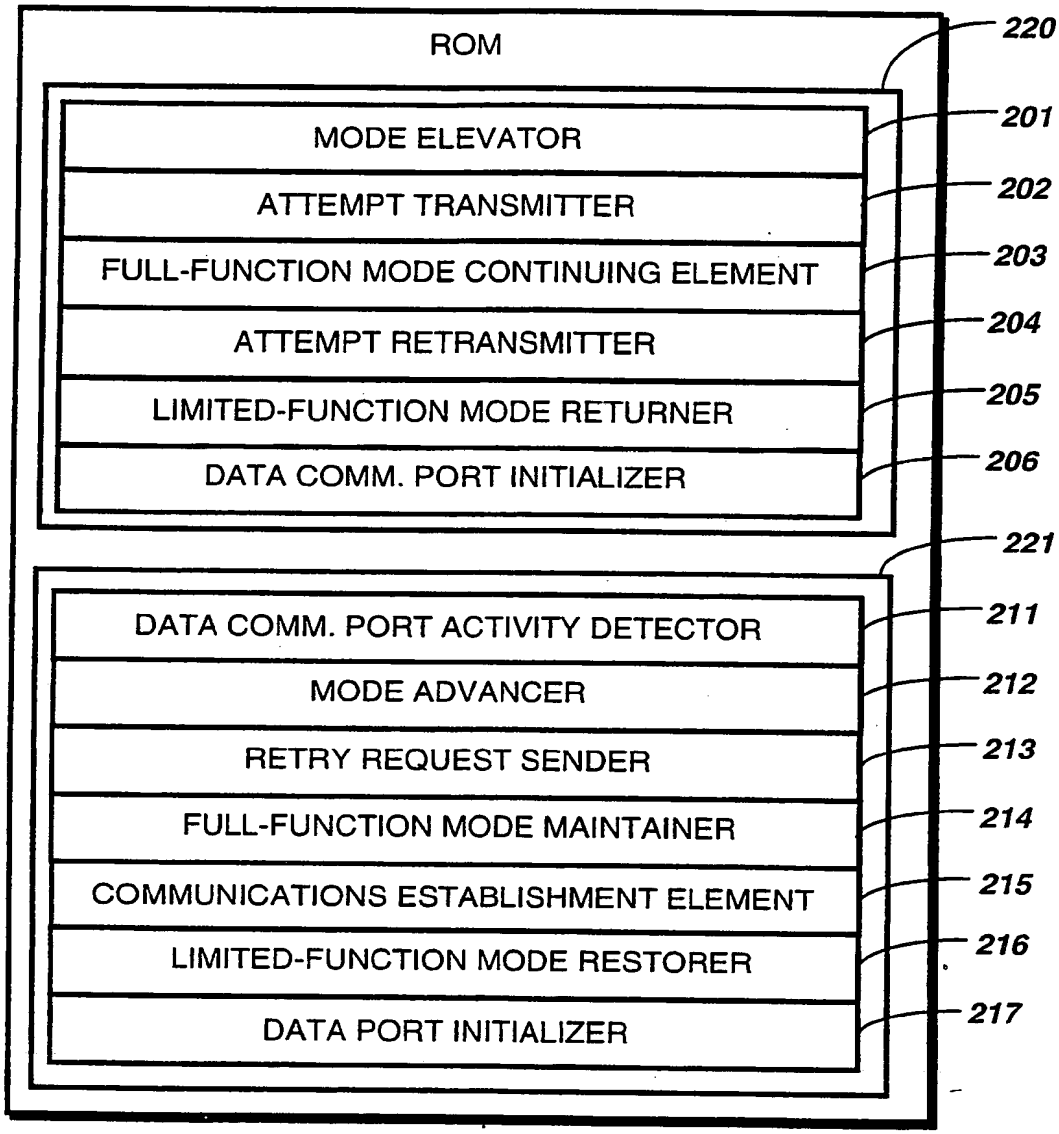


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*FIG. 2*

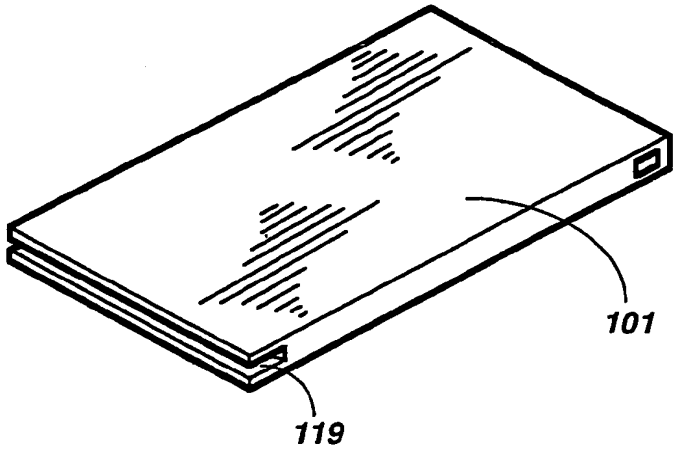


FIG. 3

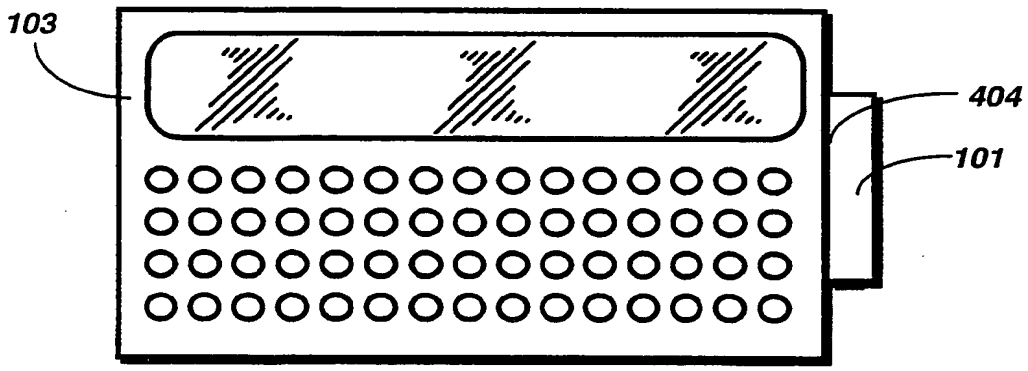


FIG. 4

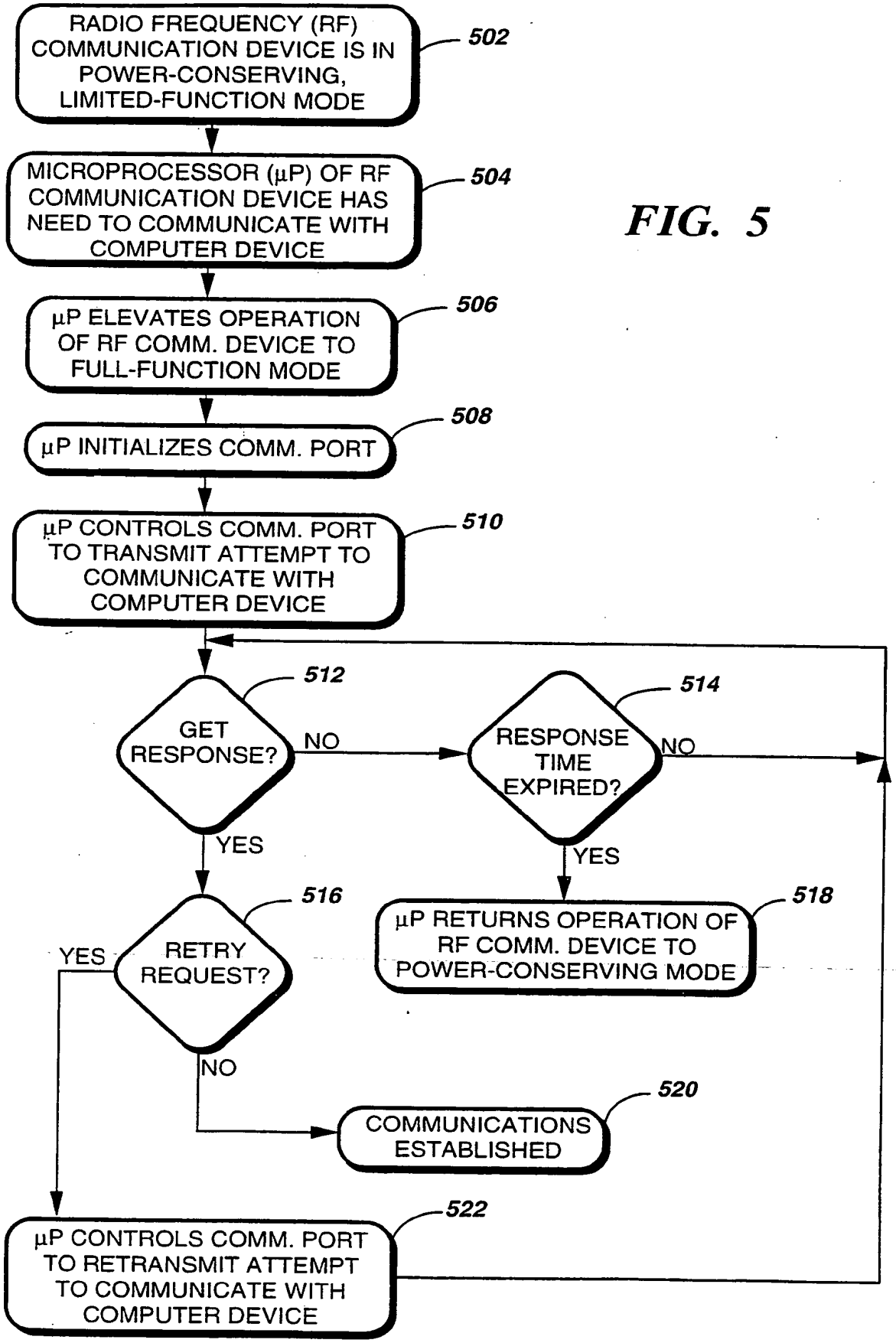


*FIG. 5*

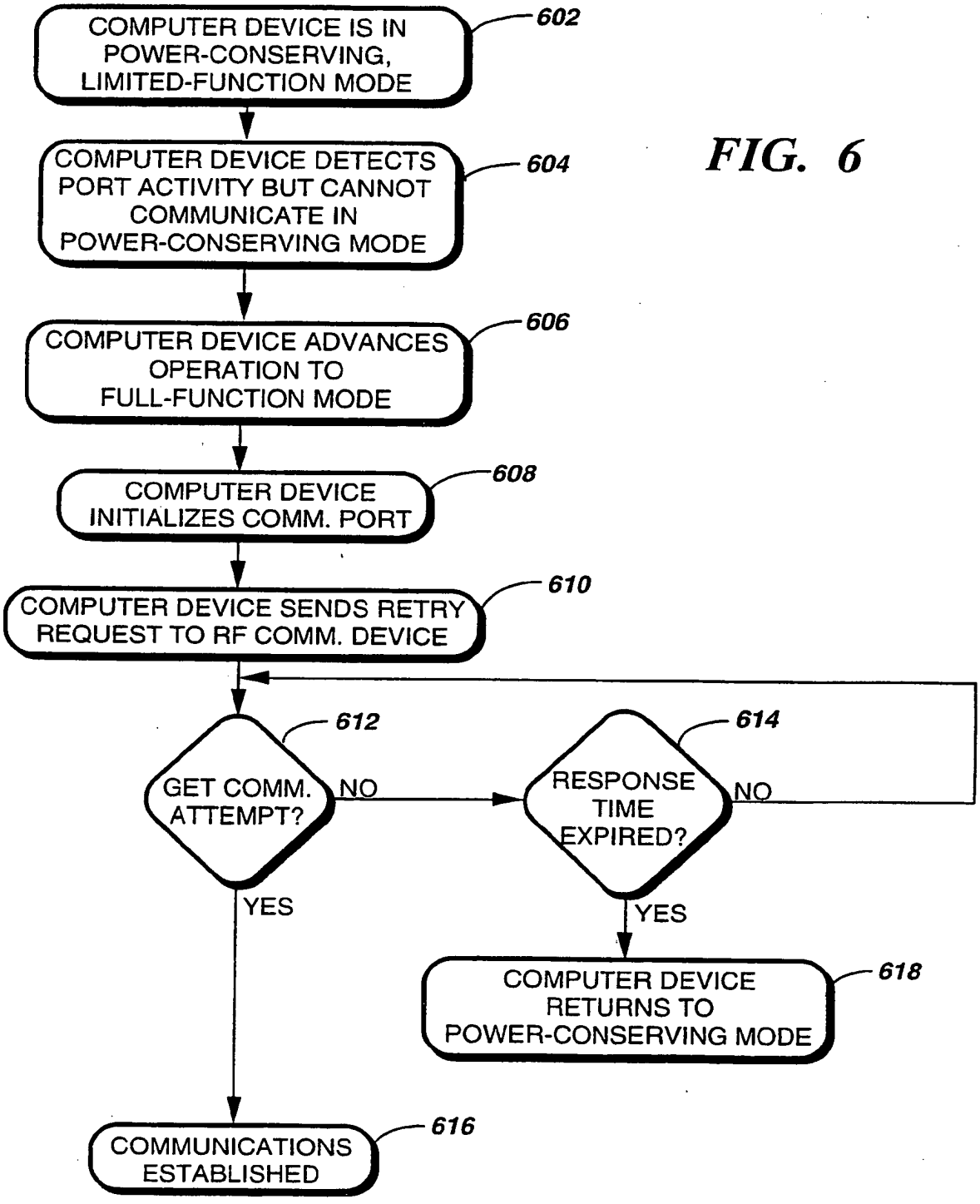
COMPUTER DEVICE IS IN POWER-CONSERVING, LIMITED-FUNCTION MODE
602
COMPUTER DEVICE DETECTS PORT ACTIVITY BUT CANNOT COMMUNICATE IN POWER-CONSERVING MODE
604
COMPUTER DEVICE ADVANCES OPERATION TO FULL-FUNCTION MODE
606
COMPUTER DEVICE INITIALIZES COMM. PORT
608
COMPUTER DEVICE SENDS RETRY REQUEST TO RF COMM. DEVICE
610
GET COMM. ATTEMPT?
612
NO
RESPONSE TIME EXPIRED?
614
NO
YES
YES
COMPUTER DEVICE RETURNS TO POWER-CONSERVING MODE
618
COMMUNICATIONS ESTABLISHED
616

FIG. 6

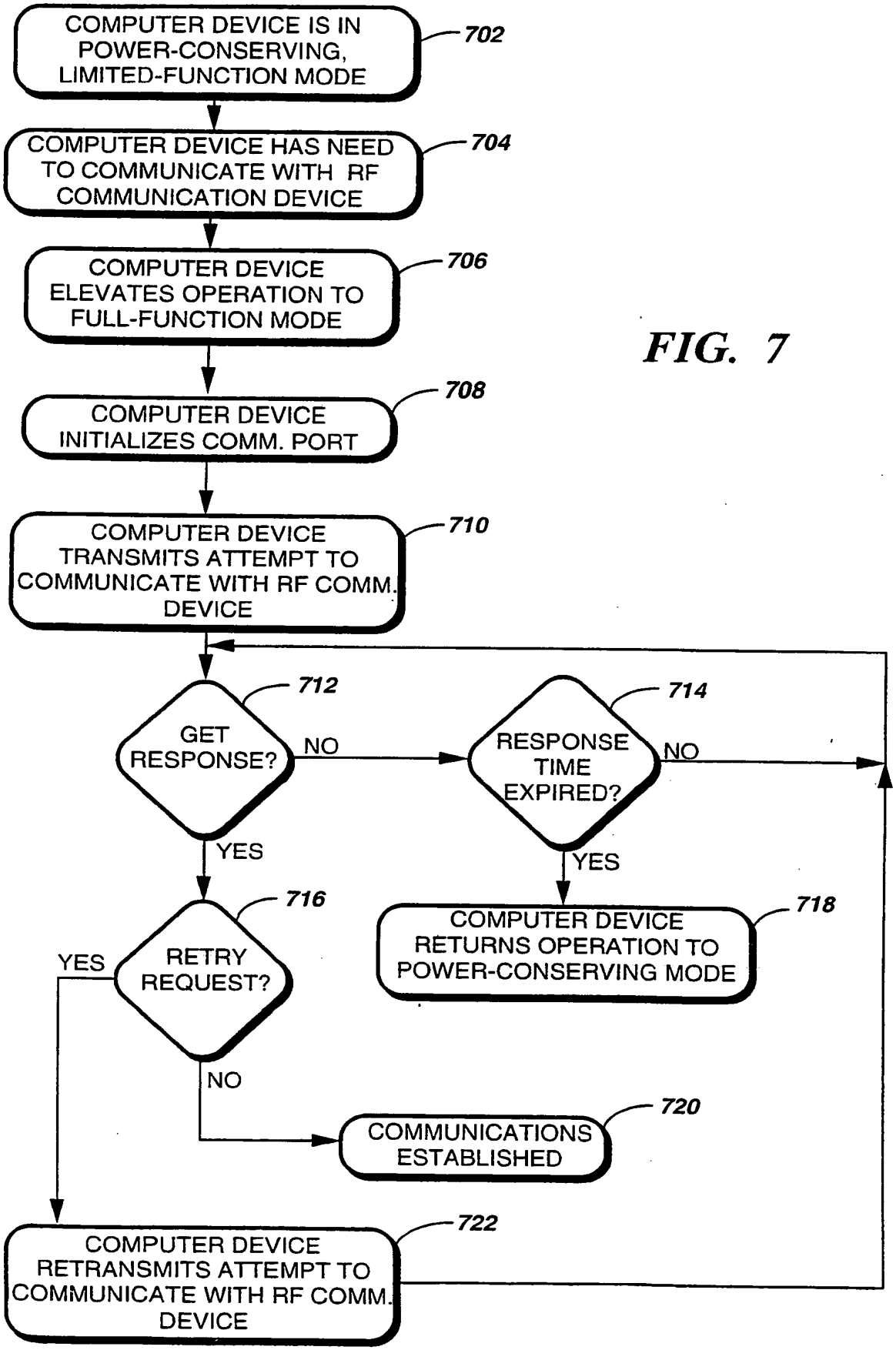


*FIG. 7*

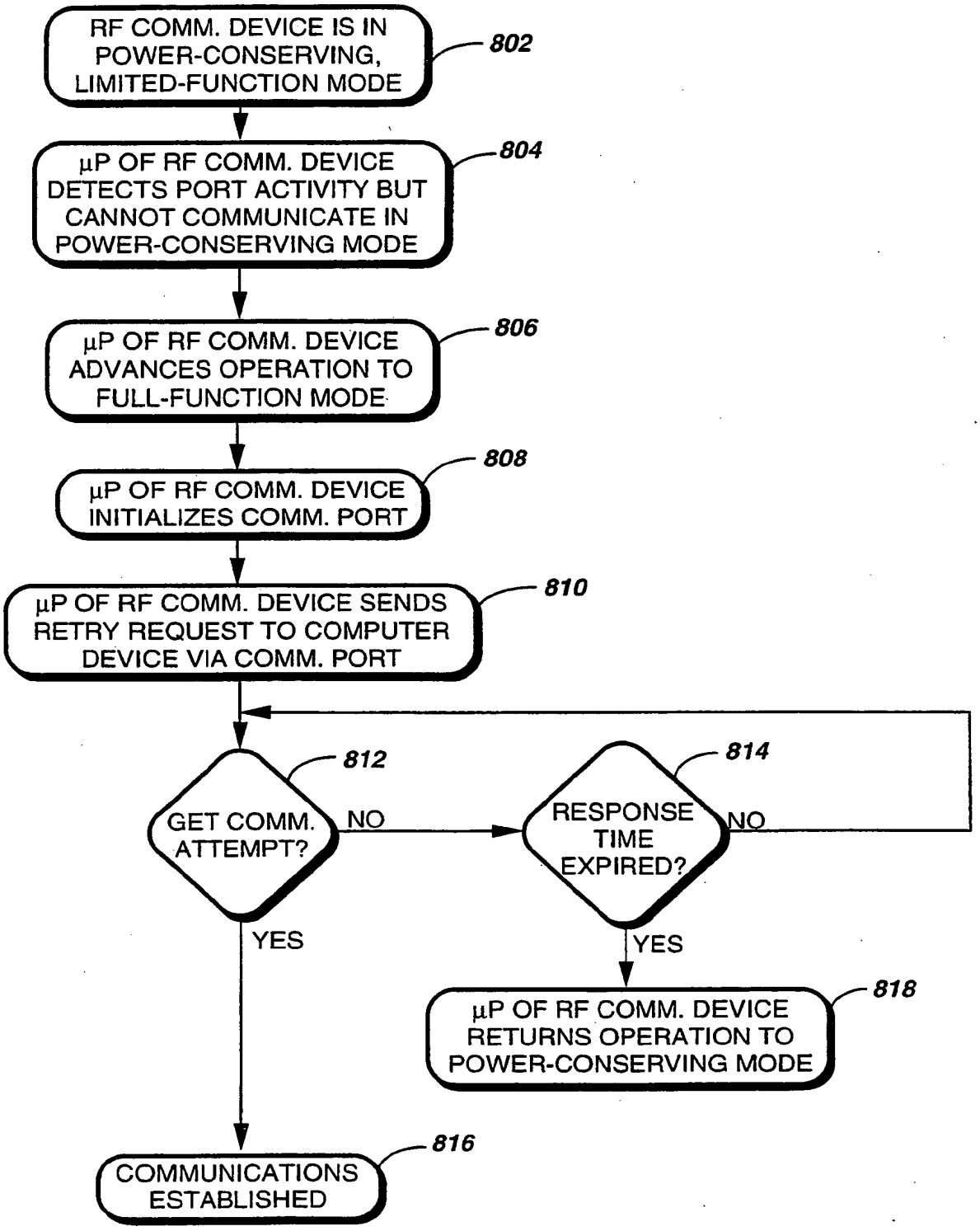
RF COMM. DEVICE IS IN POWER-CONSERVING, LIMITED-FUNCTION MODE
802
μP OF RF COMM. DEVICE DETECTS PORT ACTIVITY BUT CANNOT COMMUNICATE IN POWER-CONSERVING MODE
804
μP OF RF COMM. DEVICE ADVANCES OPERATION TO FULL-FUNCTION MODE
806
μP OF RF COMM. DEVICE INITIALIZES COMM. PORT
808
μP OF RF COMM. DEVICE SENDS RETRY REQUEST TO COMPUTER DEVICE VIA COMM. PORT
810
GET COMM. ATTEMPT?
812
NO
RESPONSE TIME EXPIRED?
814
NO
YES
YES
μP OF RF COMM. DEVICE RETURNS OPERATION TO POWER-CONSERVING MODE
818
COMMUNICATIONS ESTABLISHED
816

*FIG. 8*

# INTERNATIONAL SEARCH REPORT

Int ational application No.
PCT/US94/00775

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(5) :G08B 5/22; H04B 1/16; H04Q 1/56, 9/14
US CL :340/825.06; 455/38.3, 343

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 340/825.06, 825.44, 825.52; 364/725; 455/38.3, 343

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS, search terms: full-function mode, power-conserving mode

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | US, A, 4,839,639 (SATO ET AL.) 13 June 1989, col. 1, line 62 to col. 2, line 22. | 1-18 |
| Y | US, A, 5,089,813 (DELUCA ET AL.) 18 February 1992, col. 1, line 64 to col. 2, line 21. | 1,10,13 |
| A,P | US, A, 5,241,542 (NATARAJAN ET AL.) 31 August 1993 | 7-12 |
| A | US, A, 4,961,073 (DRAPAC ET AL.) 02 October 1990 | 1-18 |
| A | US, A, 4,775,928 (KENDALL ET AL.) 04 October 1988 | 1-18 |

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

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"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

03 May 1994

Date of mailing of the international search report

01 JUN 1994

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Form PCT/ISA/210 (second sheet)(July 1992)*